REMARKS

Claims 1, 4, 5, 7-11, 13-16, 18-20, and 24 are all the claims pending in the application. Claims 1, 4, 5, 7-11, 13-16, and 24 are withdrawn without prejudice. By this Amendment, Applicant incorporates the features of claim 19 into claim 18, and adds new claims 25 and 26.

Applicant thanks the Examiner for acknowledging the claim for foreign priority and confirming receipt of the certified copy of the priority document. Applicant thanks the Examiner for considering and initialing the Information Disclosure Statements filed on January 31, 2006, October 1, 2007, and November 27, 2007.

Claim Rejections – 35 U.S.C. § 102

Claims 18-20 stand rejected under 35 U.S.C. § 102(b) as allegedly anticipated by Lai et al. (U.S. Patent No. 5,871,650). Applicant respectfully traverses the rejection for at least the following reasons.

Claim 18 recites, *inter alia*, "a porous tubular support with both ends open". Lai does not teach, or fairly suggest, at least this feature of claim 18.

Instead, as the Examiner noted, Lai discloses a tubular substrate in claim 19. However, no disclosure is made that both ends of this substrate are open. Open ends are not taught by Lai, nor would this feature be inherent or obvious to one of ordinary skill in the art.

Further, amended claim 18 requires "grain boundary layers in spaces among the zeolite single crystals exposed on the surface of the zeolite membrane." With respect to this feature, Lai is silent on it and does not suggest it.

In Lai, there is a mesoporous growth enhancing layer on which a zeolite layer is grown, i.e., which functions as a foundation layer for the zeolite layer. The "interstitial spaces" which the Examiner cited belong to the growth enhancing layer. That is, the "interstitial spaces" disclosed in Lai bear no relation to the spaces among the zeolite single crystals "exposed on the surface of the zeolite membrane" as required by claim 18.

Next, Lai describes "columnar zeolite layers is a polycrystalline layer, wherein 99% of said columnar zeolite crystals have at least one point between adjacent crystals that is ≤ 20 Å. See claim 1. In further describing this feature, Lai states:

> The columnar cross-sectional morphology of the columnar zeolite layer is such that there are essentially no voids extending through the thickness of the layer because the columnar crystals are grown into a polycrystalline dense mat. Dense mat as used herein means that at least 99%, preferably 99.9% of the columnar zeolite crystals have at least one point between adjacent crystals that is ≤ 20 Å. In the instant invention, the spacing between the crystals is set by a grain boundary zone and the maximum grain boundary zone spacing, absent voids or defects, will be ≤ 40 Å...As used herein, a grain boundary zone is defined as the width of the disordered zone between two adjacent ordered crystals." Col. 3, lines 43-57.

Applicant asserts that Lai describes a dense mat comprising columnar zeolite crystals having substantially no spacing between crystals.

Thus, the grain boundary zone of Lai is different from the grain boundary layers of the present invention, particularly "wherein the grain boundary layers are 2 to 50 nm in thickness" as required by claim 20. As described in paragraph [0075] of the specification of the present application:

> The grain boundary layers 82 thus formed are made of oxides having a density larger than that of the zeolite crystals 81...Preferably, the pores larger in diameter than zeolite pores are not formed in the grain boundary layers 82. When pores with a large diameter are formed I the grain boundary layers 82, a good molecular

> sieve cannot be obtained. A zeolite membrane 8 including substantially dense grain boundary layers 82 exhibits a good molecular sieve effect.

Namely, the grain boundary layers are phases which have pores of small size and by which the spaces among zeolite single crystals are filled.

When grain boundary layers as described above exist, flux can become larger because molecules may be associated with each other between the crystals. Thus, with respect to the performance as a separation membrane, the zeolite tubular separation membrane of the present invention is higher than the zeolite membrane of Lai, which has substantially no spacing between the adjacent crystals. Therefore, the zeolite tubular separation membrane of the present invention is more effective than the zeolite membrane of Lai, in addition to being distinguishable based on structural features.

Claims 18-20 stand rejected under 35 U.S.C. § 102(b) as allegedly anticipated by Matsukata (U.S. App. No. 2001/0012505). Applicant respectfully traverses the rejection for at least the following reasons.

The Examiner stated, "Matsukata teaches zeolite membranes oriented perpendicular to the substrate tube (fig. 1b, 4 and example 1). Even if the reference does not explicitly state that the membrane is perpendicular to the substrate, it appears to be so from the figures, and would also be inherently so from the hydrothermal sythesis process." Applicant respectfully disagrees.

Matsukata discloses a "mordenite (MOR) zeolite membrane dominantly oriented in a specific crystalline direction" [0017]. There is no indication that the disclosed membrane is perpendicular to a tubular support surface; in fact, Matsukata's invention teaches that the "crystalline direction is not particularly limited and, it is oriented along any one of the a axis, b

axis and c axis" [0019]. In using three axes to describe the orientation, Matsukata seems to employ a Cartesian (rectangular) coordinate system. However, a tubular structure would be best analyzed using a cylindrical coordinate system, something that is not disclosed anywhere in Matsukata. A direction that is perpendicular to points along a circular object is not contemplated and not disclosed when Matsukata teaches orientation in a rectangular coordinate system.

Furthermore, disclosure of a perpendicular orientation of the substrate with respect to the ground is not the same as a perpendicular direction of the membrane with respect to the substrate. Therefore disclosures such as "surface of said substrate on which a membrane is formed becomes perpendicular" [0025] do not anticipate crystals formed perpendicular to the substrate itself.

The Examiner cites Example 1 of Matsukata and states that it "teaches zeolite membranes oriented perpendicular to the substrate tube". Although this embodiment does contemplate the use of a "porous alumina tube" it does not disclose a perpendicular orientation [0030-0031]. The example states that the membrane is "dominantly oriented along the b-axis", but even with reference to Fig. 1a and 1b it is not clear in what direction the b-axis runs. Thus Matsukata does not disclose a perpendicular direction with respect to this example or the cited figure.

Matsukata discusses the use of a tube as a substrate in another embodiment, but does not disclose a perpendicular orientation of a membrane with respect to the tubular structure of the substrate. Instead, Matsukata discloses "a mordenite (MOR) zeolite membrane dominantly oriented along the c axis which was oriented ***in parallel*** with a substrate of the porous alumina tube" [0037] (emphasis added). This teaches away from the claim language "perpendicular to

the surface of the porous tubular support". Therefore, Applicant respectfully argues that the invention disclosed in Matsukata does not anticipate all features of amended claims 18 and 20.

Further, the Examiner stated, "The grain boundary layer thickness in the range 2-50 nm would be an inherent property of the zeolite crystals." Applicant respectfully disagrees.

There is no disclosure or suggestion in Matsukata which can be the basis of the inherency argument made by the Examiner. To begin with, Matsukata is silent about the grain boundary layer and the zeolite membrane of Matsukata appears to be one which has substantially no spacing between the adjacent crystals.

As mentioned above, when the grain boundary layers of the present invention exist, flux can become larger. Thus with respect to the performance as a separation membrane, the zeolite tubular separation membrane of the present invention is higher than the zeolite membrane of Matsukata, which has substantially no spacing between adjacent crystals. Therefore, the zeolite tubular separation membrane of the present invention is more effective than the zeolite membrane of Matsukata, in addition to being distinguishable based on structural features.

Also, for similar reasons to those discussed above with respect to Lai, Matsukata does not disclose a tubular structure "with both ends open" as required by claim 18.

Claim Rejections - 35 U.S.C. § 103

Claims 18-20 stand rejected under 35 U.S.C. § 103(a) as allegedly obvious over Matsukata. Applicant has argued above that Matsukata fails to disclose or suggest all features of the claimed invention. Thus, Applicant respectfully traverses the § 103 rejection and requests the Examiner to withdraw the rejection for at least the reasons discussed above.

New Claims

By this Amendment, Applicant adds new dependent claims 25 and 26. Claim 25 is supported in the specification at least at page 17, paragraph [0037]. Claim 26 is supported in the specification at least at page 11, paragraph [0026]. Claims 25 and 26 are patentable at least because of their dependency from independent claim 18.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880 via EFS payment screen. Please also credit any overpayments to said Deposit Account.

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